JAN 25 1912

JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

Entered as second-class matter May 7, 1906, at the Post Office at San Francisco Cal., under the act of Congress March 3, 1879

VOL. XXVIII NO. 3 SAN FRANCISCO, JANUARY 20, 1912 PER COPY, 25 CENTS

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JOURNAL OF ELECTRICITY
POWER AND GAS
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VOLUME XXVIII | SAN FRANCISCO, JANUARY 20, 1912 | NUMBER 3

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RECONSTRUCTION OF FORDYCE DAM

BY E. L. DODGE.

Lake Fordyce, one of the largest storage reservoirs of the Pacific Gas & Electric Company, with an area of approximately 510 acres, and 875,000,000 cubic feet capacity, is situated far in the eastern part of Placer County, and about seven miles from the summit of the Sierra Nevada Mountains. The lake is about eight miles due north of the Southern Pacific Railway tracks passing Cisco station, and can best be described as an immense basin, surrounded by high and precipitous mountains of granite, and consequently almost inaccessible except by foot travel or by horse-back over rough mountain trails.

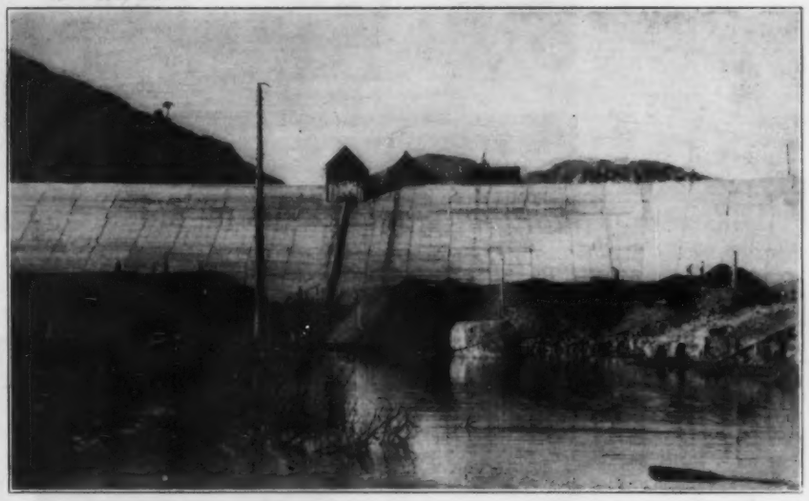

Fig. 1. Fordyce Dam, Showing Location of New Tunnel.

The retaining dam at Fordyce is practically 800 ft. long, 139 ft. thick at the foundation, five feet across the top, and 92 ft. high. This dam was built years ago for the purpose of storing water in conjunction with the old South Yuba Water Company system. The face of the dam is at present sheathed with heavy planking (see Fig. 2). In the spring of 1911 it was decided to put in a concrete cut-off wall along the entire toe of the dam and also to reinforce the crest of the dam, block the old spillway, and build a new outlet tunnel. Fig. 1 shows the excavation necessary to establish a permanent and solid foundation at the toe of the dam for the cut-off wall.

In order to carry on this construction work, it was necessary to practically empty the lake of its water (see Fig. 3), and establish a permanent headquarters camp adjacent to the work to care for the two hundred-odd men needed in this reconstruction.

Owing to the almost impassable mountain barriers between Cisco, on the line of the Southern Pacific, and Lake Fordyce, the immense amount of construction material, consisting of heavy machinery, such as air compressors, boilers, hoisting equipment, tram cars, etc., necessary to carry on this gigantic work, was taken in a long detour from Truckee north by way of Weber Lake, a two-days' haul, and down into the northern end of Lake Fordyce, thence by boat and rafts to the dam. The camp supplies for the commissary were taken in by pack trains from Cisco over the mountains. When this work is entirely completed, the Fordyce Dam will be in excellent condition for many years to come.

Fordyce is at an altitude of 6,300 feet above sea level, and even as late as July 1st oftentimes snow remains upon the ground, and the nights are sharp with heavy frost. The first winter snows fell at Fordyce, October 25th, 1911. The season, consequently, when work can be performed in these mountains is extremely short. Eighteen to twenty feet of snow is the usual winter's depth, and the headquarters house shown in illustration, Fig. 4, is oftentimes buried, so that the two lake tenders are compelled to enter and leave by the window shown in the extreme top of the gable end.

This picture also shows wood being stored for the long winter season, and on the porch are a number of Norwegian skis, which are used in traveling over

the country during the winter months. El Roenig, in charge of Lake Fordyce, has lived in these mountains as caretaker of Lake Fordyce, Sterling and Meadow Lake for 39 years. His only companion is Gus Anderson, and many times these two rugged Scandinavians pass several months during the extreme winter, snowed in and ice-bound, without ever seeing a human being. When it is possible to get out, and the snow is tightly packed. they take a little jaunt on their skis over the mountains to Cisco and back again, a distance of about 16 miles. Uphill and downhill they wend their way, being experts on snow shoes, and where the going is good they indulge in long coasting spurts of several miles.

A large portion of the bed of Lake Fordyce was at one time rich meadow and timber land, and, in fact, a large ranch occupied one end of the valley. In Fig. 16 old stumps of what were at one time standing trees can be seen, and are now almost entirely submerged except at extremely low water.

Lake Fordyce abounds in fine trout, which are being preserved by the Pacific Gas & Electric Company during this construction work, small dams having been built and sufficient water retained to care for the fish until the lake is again refilled.

South Yuba System.

Lakes.	Acres.	Capacity (Cu. Ft.)
Blue Lake	63	49,000,000
Bear Valley (reservoir)	60	14,000,000
Culbertson Lake	67	30,000,000
Feeley Lakes	67	37,000,000
Fuller Lake	67.5	40,000,000
Lake Fordyce	510	875,000,000
Lake Spaulding	215.5	254,900,000
Lake Sterling	104	71,800,000
Lake Valley Lakes	260	230,000,000
Lake Van Norden	390	230,000,000
Lindsey Lake	49.3	13,300,000
Meadow Lake	249	200,000,000
Rock Lakes	23.9	10,300,000
Rucker Lake	63	22,600,000
White Rock Lake	90	180,000,000
Totals	2,279.2	2,257,900,000

DITCH FLOW EACH SECOND.

Canal.	Cu. Ft.	Miner's Inches.
Main South Yuba	200	8,000
Boardman	75	3,000

Fig. 2. Face of Fordyce Dam.

Fig. 3. Bed of Lake Fordyce.

Fig. 4. Headquarters House, Lake Fordyce.

PHYSICAL VALUATION OF ELECTRICAL PROPERTIES IN OREGON.[1]

BY R. H. DEARBORN.

The appointment of state commissions for the purposes of taxation and regulation of public service corporations is rapidly becoming the practice of the more progressive States. The evils of competition in public utilities. the abuse of certain privileges and the necessity for some fair basis of rates to different classes of customers have all demanded the services of a just judge, who will recognize at once the rights of the public to fair and reasonable service, and the rights of the corporation to a fair return on their investment.

This arbiter of public and private rights is at present represented by the state commission in some form, and the development of the commission plan is thought to be a probable solution of the problem. The case for the state commission is well presented by Governor McGovern of Wisconsin in a recent address before the Conference of Governors on the subject of "State Control of Public Utilities," reported in full in the Electrical World for September 23, 1911, and dealing especially with results in his own state. His discussion brings out the fact that a properly constituted commission may accomplish results that are beneficial both to the public and to the operating company; to the people in improved service and a fair rate and to the average company by eliminating competition, and sometimes by improving their methods of operating and accounting.

Thomas N. McCarter, president of the New Jersey Public Service Corporation, at one time opposed to the commission plan of regulation, has recently gone on record as believing in public utility legislation as a protection to the corporation rather than a menace.

On the other side of the question the possible failure of the commission plan to be fair in the regulation of rates of public service corporations is suggested by H. M. Byllesby in an article in the Proceedings of A. I. E. E. for September, 1911, in which he calls attention to the grave responsibilities resting on the engineers for the commission in determining what is a fair and just rate for service rendered in the case of a large corporation with its varied and intricate financial problems, all of of which must be considered and passed upon before any estimate of a fair rate can be made.

Two of the more important lines of work undertaken by state commissions that affect the electrical corporations are: (1) regulation of rates, service, and accounting, (2) physical valuation for purposes of taxation. These are closely allied, the second being an important part of the first, although at times separate. Regulation of rates, service, etc., present very much the larger problem; the variables are increased by many so called intangible values by the going value, etc.; factors which demand from the engineers of the commission handling these quotations an unusual business ability, a keen insight into the operating conditions, and a rare sense of justice. The second point, the physical valuation of the properties for furnishing the basis for taxation, is but one phase of a large question before the country today; the discussion of methods for taxation of public utilities. This question, however, is beyond the scope of this paper.

The physical valuation according to the Wisconsin law should include "all the physical property, and all property used and useful for the convenience of the public." This physical valuation for taxation purposes should include (1) all real estate, (2) all materials entering into the construction, (3) all transportation and labor charges, (4) all fees for engineering and supervision. Valuation for rate making or for purchase should include in addition to the above the socalled intangible values.

The legislature of the State of Oregon at its last session passed a bill creating a Public Utilties Commission having under its jurisdiction the question of rates, service, valuation, etc., of public utilities. This bill after passage was held up by referendum and will finally be passed on by a vote of the people in November, 1912.

The work of appraisement of electric properties of the State of Oregon for purposes of taxation was recently taken up more definitely by the present tax commission for the purpose of beginning the compilation of accurate valuations. This work of physical valuation of these properties operating in more than a single county of this State was undertaken by the writer at the request of the commission during July, August, and September, 1911. The plan first considered by the commission called for a detailed investigation of one or two properties during the summer, but because of the inaccurate character of previous valuations it was decided by the commission to make an approximate estimate of all the electrical properties taxable by the State to insure that all operating companies should be on the same basis with regard to taxation; this to be followed by an accurate and detailed estimate to be taken up at a later date when circumstances permitted.

The systems of which approximate physical valuations were made included the Oregon Power Company in the Willamette Valley, the Rogue River Electric Company, and the Klamath Falls Power Company in Southern Oregon (both recently absorbed by the Siskiyou Power Company), the Pacific Power & Light Company in the Astoria and Pendleton districts, and the Eastern Oregon Light & Power Company serving Baker City and the Grande Ronde Valley. The Portland Railway Light & Power Company had recently turned in a report so this company was not included.

The number of companies and the large amount of territory to be covered in a very short time made it necessary to adopt some system that would approximate the actual valuation and insure an equable assessment for all the companies without the labor and time required for accurate estimates of all the details of construction and the separation of items of engineering, supervision interest during construction, contingencies, etc. Therefore, these latter items were combined in one percentage depending on the local conditions.

Physical valuations are usually based on one of two methods: (1) Original cost of the installation, less depreciation, (2) Cost of replacement new, less depreciation. Because of the meager and inaccurate records of many of the original companies, most of which had

[1]Paper presented before Portland Section A. I. E. E., Dec. 21, 1911.

changed hands several times, it was impossible to get first costs of many of these properties, so the latter method was employed.

The work consisted of the inspection of all real estate, plants, sub-stations, transmission lines, and distributing systems, and their appraisement on this basis of replacement new, less depreciation for the number of years installed. The errors of this assumption are due to the difference in costs of material and labor now, and at the time of erection; and the larger difference between construction completed at one time and the so-called piece meal construction. Rates of depreciation on power houses, sub-stations and all machinery installed were based on the figures given by Mr. Henry Floy in the Proceedings of the A. I. E. E. for June, 1911, The straight line method was adopted because of its simplicity.

Rates of depreciation on transmission lines and distributing systems were based on the average life of such systems in that locality, taking into consideration the materials, type of construction, and climatic conditions. The valuations of the distributing systems in the towns were based on the number of poles, miles of wire, number and capacity of transformers, meters and services. A large percentage of these figures were taken from company records, which were available, but in some cases these were estimated from average figures obtained from statistics of similar towns similarly served in this State. Depreciation was figured on the average life of the distributing system.

The actual valuations made on the electrical properties are believed by the writer to be uniformly low. This is due in part to causes already mentioned. Two of the most important of these are: (1) The well recognized difference between costs of construction work carried out completely at one time, and the costs when the same work is carried out by a series of additions, the latter the usual conditions in the case of companies serving rapidly developing communities. (2) The limited time available for covering a large territory; the impossibility of making complete investigation of transportation and labor costs, of foundations, and hydraulic work will be readily recognized.

One of the interesting features brought out by the work was the grouping of the various districts of the State for the electrical service. (At this point a map of the State showing the districts served by the various companies was shown and a brief description of each system was given bringing out the interesting features of each.)

As shown by the map of the Umpqua Valley is the only populous area, which is not served by one of these five companies. A further evidence of the completeness of this distribution is shown by the fact that of the twenty towns of the State which have more than two thousand population according to the last census but three are not served by one of the companies.

Some of the figures obtained for the distributing systems may be of interest, showing the uniformity in towns of similar size, even where the type of load is somewhat different. Below are tabulated the figures of the distributing systems of ten towns with population ranging from four thousand to ten thousand reduced to a basis of one thousand population.

					Transformers		
	Poles.	Miles of Wire.	Meters.	Services.	No.	Capacity kw.	Average Capacity per Tran.
1	125	10	170	207	14	118	8.5
2	108	10	150	163	13.3	106	8
3	116	10.6	126	140	12.6	70	5.5
4	120	11.1	101	132	15.1	151	10
5	123	9.5	114	125	13.3	91	7
6	105	10	160	160	10	119	11
7	50	8	108	125	9.3	70	7.5
8	110	9.5	150	150	22	124	5.5
9	170	10	112	112	19	92	5
10	160	12	45	125	17	85	5

Approximate averages:

Per 1000 population.				Transformers.		
Poles.	Miles of Wire.	Meters.	Services.	Number.	Capac. in kw.	Aver. Capac. per Tran.
120	10	125	145	14	105	7.5

In several instances there are figures very different from the average, due to local conditions, but on the whole, I believe the averages are close enough for approximate estimates on towns in Oregon between the limits of population mentioned.

Many interesting facts came out in connection with the summer's work, but these few will serve to show some of the questions to be considered in an appraisement of the electrical systems of the State. It is to be sincerely hoped that the work of the commission in Oregon will be extended until the State has accurate data available for the various and important uses of the commissions. The State is comparatively new, and the problem undertaken at this time should be much easier of solution than in the other States which have a larger number of systems with larger investments in public utilities. With an accurate estimate of the electrical properties at present existing in the State the yearly additions made by the companies could be easily estimated, keeping these valuations up to date with comparatively slight expense to the State.

The increasing distance over which electrical power may be transmitted economically and the undoubted gain that comes from consolidation of many plants in a larger network points to the ultimate combination of several of the systems, which are now considered large, in a greater system with great improvement in diversity factor and in load factor, due to irrigation and electrical heating loads, which will probably result in lowering of rates and improved service

Companies of this type with the courage to expand a little ahead of the development of the country, with their close organization, and the highest engineering and financial ability available, are the first to recognize the value of a rightly constituted commission, which will portect, not only the interests of the people but that of the public service corporation as well.

WIRELESS FIGHTING OF FOREST FIRES.

Wireless telegraphy will become a factor in the prevention of forest fires in Montana, if experiments planned by R. P. McLaughlin, forest supervisor, are successful. It is proposed to establish a station and open communication with the wireless plant at the Kalispell High School. If the experiment is successful several stations to be operated in connection with the telephone system already in operation, will be organized.

DRILLING BOILERS IN THE CALIFORNIA OIL FIELDS.

BY A. L. MENZIN.

In the selection and installation of mechanical equipment, the personal preferences of men play only a minor part in comparison with the dictates of local conditions. The effects of high costs of materials and scarcity of skilled labor and transportation facilities are particularly noticeable in the oil fields, especially in the crude and make-shift manner of setting the steam boilers used in drilling and pumping.

Owing to the many complex operations involved in the drilling and upkeep of wells, apparatus, as well as methods, have been standardized to a high degree. For drilling purposes, and for pumping the well after it is made productive, until superseded by a more permanent plant, the boiler commonly used is of the horizontal return tubular type, 48 inches in diameter by 12 feet long, with forty 3-inch tubes expanded between heads. They are built for 100 pounds working pressure. Since good water is seldom obtainable, it is necessary to provide facilities for cleaning; hence there is usually a manhole in the front head below the tubes and another manhole in the rear head above the tubes. Although manufacturers of this type of boiler frequently put a manhole in the top of the shell instead of in the rear head, such an arrangement would not be satisfactory for oil country service since the top of the shell is usually covered with loose dirt or oil sand to decrease the loss of heat by radiation and conduction. Boilers are usually fitted with steam domes for, in drilling and cleaning wells, sudden demands for steam are not uncommon.

Fig. 1. Boiler Setting With Steam Dome.

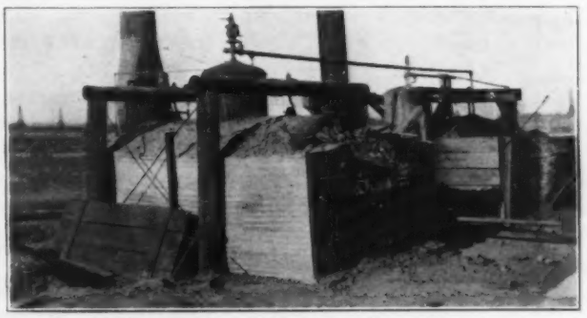

Fig. 2. Rear View of Boiler Setting.

The stacks are of sheet iron, and are usually 22 inches in diameter and 20 feet long. Dampers are not installed as a rule.

Although boilers of the type described are very common wherever steam is used, the method of setting them adopted in the oil fields is entirely different from that met with elsewhere. The photographs, Figs. 1 and 2, show a front and rear view of the typical "mud settings." Both boilers are suspended from gallows frames by means of bolts linked with hangers riveted to the top of the boiler shell. The distance from the ground to the bottom of the shell is usually about 30 inches. The sides and rear of the setting are made up of a 13 or 18 inch wall of red brick laid up dry without mortar and backed up with dirt to make the walls about 30 inches thick. The dirt is kept in place by boards or sheet iron on the sides and castings at the rear. The roof of the rear uptake is of red brick supported by 90-degree arch bars which rest on the rear wall and against the boiler. A layer of dirt or oil sand is thrown over this roof and over the top of the shell for obvious reasons. The furnace floor is of dirt. Fire brick is seldom used in these settings.

The left hand boiler of Fig. 1 is erected with the older type of mud setting. The gallows frames are made up of square timbers and the retaining walls for the dirt are also of wood. The right hand boiler has the newer type of setting. The gallows frames are made of old well casing and the retaining walls are of corrugated sheet iron. This latter setting is fireproof and is now used whenever the material required are available.

There are many good reasons for the adoption of such a setting in the oil fields. Brick, lime, sand and cement are very expensive, and bricklayers are scarce. It frequently happens that a boiler has to be moved, either because the well is abandoned, or for other reasons. It is then a simple matter to pull down the boiler and setting, move the materials to the new site and erect them again with the ordinary labor available. Such a setting is, of course, not conducive to high efficiency but that, as in all development work, is secondary to low first cost.

Patented oil burners are practically unknown in the oil fields. Every operator makes his own burner out of ordinary pipe fittings. The construction varies somewhat, depending on the personal ideas of the maker and the quality of the oil burned, but the general principle is illustrated in the sketch, Fig. 3. These burners make a very satisfactory fire and seem to require very little steam for atomizing since it is only necessary to "crack" the steam valve a very little to make a good forty horsepower fire. No oil pumps are required or used—the oil being supplied by gravity from a tank set from 6 to 10 feet above the ground. However, these burners will operate with a much lower head of oil. The writer has made a good fire with one of these burners when the surface of the oil was not more than 3 feet above the burner.

An important peculiarity of this burner is that it is self-regulating to a great extent. The impact of the jet of steam issuing from the inner pipe against the burner tip produces a back pressure on the oil issuing from the annular space between pipes. If the steam valve is adjusted for good atomization, any increase of the steam pressure will cause more steam to flow through the inner pipe. This will increase the back pressure at the tip and choke back the oil coming from the annular space, thus decreasing the fire. If, on the

other hand, the steam pressure drops, the back pressure at the tip will be decreased, more oil will flow, and the fire will be increased.

This type of burner is very sensitive to variations in steam pressure. As the steam pressure goes up the fire is cut down until a point is reached when the fire

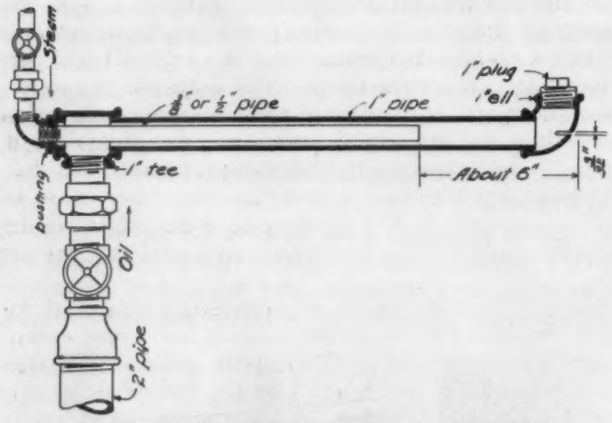

Fig. 3. The "Home-Made" Burner of the Oil Fields.

becomes spasmodic—it almost goes out and then starts up again with explosive action. It is then said to "buck."

Another peculiarity of the burner is that it will begin to atomize when the steam pressure is less than a pound above atmospheric. As soon as a "sizzle" is heard issuing from the steam pipe and before the needle of the steam gauge has left the pin, the burner will begin to atomize and will make a fairly good fire.

HYDROELECTRIC DEVELOPMENT IN MEXICO.

It is learned from an apparently reliable source that, through a concession, the German firm of Siemens & Halske, of Berlin, will shortly begin the construction of a large hydroelectric plant on the Balsas River in the State of Guerrero at the point where the main highway between the capital, Chilpancingo, and the city of Iguala crosses the same, that the sum of $14,000,000 is available therefor, and that the purpose of the plant will be to supply power for the many and important mines of this State along the Balsas River.

Salvador Ugarte has secured a contract for the installation of a new electric power plant at the mines of Guadalupe de los Reyes, Sinaloa.

These properties are among the most famous producers of the west coast interests. The new plant will consist of two charcoal gas-producer engines of 180 horsepower each, a reserve battery of two electric generators of 120 kilowatts each. It is expected to have the plant in operation by May, 1912. The new plant will greatly reduce the operating costs of the mines and reduction plant.

METER DEPOSITS HELD INVALID.

The practice of gas, electric and water companies of requiring deposit fees for the installation of meters has been held to be invalid by the State District Court of Appeals of California. The San Francisco Gas & Electric Company will carry an appeal to the State Supreme Court.

THE GRAPHICAL CONSTRUCTION OF AN INDICATOR CARD.[1]

BY ROBERT SIBLEY.

It not infrequently happens when taking indicator cards from a steam engine that a theoretical indicator card drawn to the simple scale of the card taken by means of the indicator appears of much practical import and comparison between ideal and operating conditions is at once noted and means of correcting irregularities suggested. It is possible to construct an ideal indicator card if we have given certain of the constants of the engine cylinder in question. These constants consist of the boiler pressure, the back pressure, point of cut-off, length of stroke, the point of compression, and the clearance.

In Fig. 1 we have an indicator card constructed from an engine cylinder having the boiler pressure of 80 lb. gauge and back pressure of 1.3 lb. gauge, the point of cut-off four inches out from the beginning of the stroke of 12 in. and clearance of 0.1 stroke or 2.4

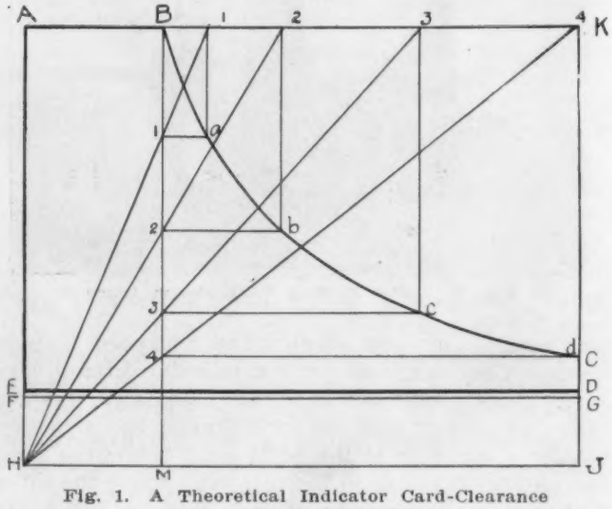

Fig. 1. A Theoretical Indicator Card-Clearance Neglected.

inches. In the construction of this card we first start with the line FG which is the zero line for gauge pressures and is commonly known in engineering practice as the atmospheric line. Selecting a point at F we next measure to a convenient scale the distance FH perpendicularly below FG a distance equal to 14.7 lb. or the pressure of the atmosphere above the absolute zero. We next extend FH vertically upward to A the distance FA being equal, on the same scale with which we drew FH, to 80 lb. The distance FE is next scaled off equal to 1.3 lb. which is in this case the pressure in lb. gauge of the exhaust steam as it leaves the engine cylinder. Through E and A we next draw the line ED and AB parallel to our atmospheric line FG. The point G is located to scale 24 in. to the right of point F, thereby making FG equal to the stroke of the engine cylinder. The point B is next located on the line AB distant 6 in. to the right of point A, thereby making the line AB equal to the distance from A at which the cut-off point B is located during the stroke of the piston head.

The next point of interest for our consideration is the construction of the expansion curve BC. We

[1]This paper comprises the Seventeenth Lecture of the series appearing in these columns entitled "Primer of Applied Thermodynamics."

have previously seen that this curve is neither one of isothermal expansion nor adiabatic expansion but is situated intermediate between these two curves. As it approaches however more nearly the isothermal curve and as the isothermal curve is easily constructed, engineers generally assume that the curve is one of isothermal expansion. Fig. 1 represents an expansion curve BC in which the steam engine cylinder has no clearance. Fig 2 on the other hand represents a cylinder which has a clearance equal to 0.1 of the stroke. Let us first take the more simple case, that shown in Fig. 1 and see how we construct the expansion curve BC. We first produce the line AB to the right to K a sufficient distance to cover the stroke of the engine and platted to the same scale in which the point of cut-off B has previously been platted on the line AB. We next take any number of points, 1, 2, 3, etc., along the line BK. The more points we take, the more points we will eventually determine on our expansion curve. Let us next draw the perpendicular BM from B to the

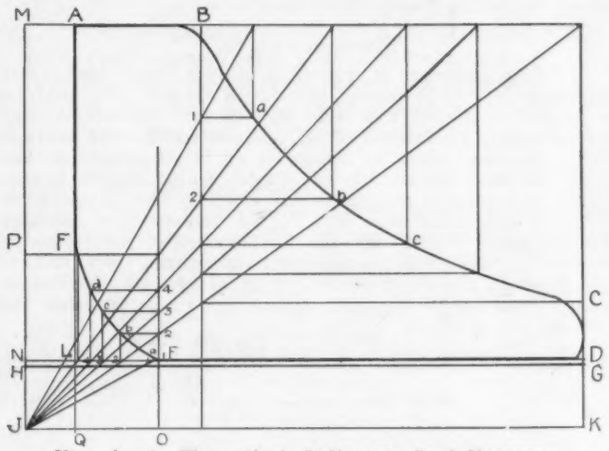

Fig. 2. A Theoretical Indicator Card-Clearance Considered.

line HJ. We then draw a straight line lH and where this line intersects the line BM we draw a horizontal line la to intersect the perpendicular line la. This point of intersection a is a point upon our expansion line. In identically the same way the points b, c, d, and any other points we desire to ascertain are determined. Finally the point at which the curve BC intersects the perpendicular GK is the termination of our curve.

Looking now at Fig. 2 we can at once extend the identical reasoning which we applied above to the case in which our engine cylinder has a certain amount of clearance. Let us construct this diagram in identically the same way we constructed Fig. 1, with the exception that the line QJ is located to the left along our absolute zero pressure line a distance equal to 0.1 of our stroke or 2.4 inches, as this is the amount of clearance given in this particular example. If now we use the point J in Fig. 2 in identically the same way we used the point H in Fig. 1 we construct at once the expansion curve BC for this particular case of clearance. In Fig. 1 the points B and C are theoretically located. As a matter of fact in the operation of the steam engine it takes time in which to open the valve, hence these points are shown ordinarily in practice more in a round shape BCD as indicated in Fig. 2.

Having now constructed the expansion curve, let us next proceed to the compression curve. Looking again at Fig. 2 let us assume in this case that compression takes place after the piston head has travelled 20 in. on its return stroke. Marking off then DE on our scale equal to 20 in. we next let drop a perpendicular line EO extended in both directions from E. Along the line EN we take a number of points 1, 2, 3, 4, etc. and draw lines 1J, 2J, 3J, etc., producing them upwardly to the right. At the intersection of the vertical perpendicular 2b line with the horizontal 2b we determine the point b which is a point on our compression line FE. In identically the same way the points a, c, d, etc., are determined on the compression curve EF. It is seen similar to the case in the construction of the expansion line that as many of these points are determined as we desire. Thus ABCDEF represents the ideal theoretic indicator card.

In the year 1902 a committee of the American Society of Mechanical Engineers made the report on engine tests which is printed in the transactions for that year. Among other things taken up in detail in this lengthy report of 78 pages is that of the question of determining the point of cut-off. We have seen that theoretically the point of cut-off is a definite point but practically speaking, due to time necessary in the opening of the steam valves, the point of cut-off is not so definite. As a matter of fact, though somewhat indefinite, the point of cut-off is usually considered to be at an earlier point of the stroke than the beginning of the real expansion line. In order that the cut-off point may be defined in exact terms for commercial purposes as used in steam engine specifications and contracts, the committee above referred to, recommended that unless otherwise specified the commercial cut-off which seems to be a preferred expression for this term, be ascertained as follows: through a point showing the maximum pressure during admission, draw a line parallel to the atmospheric line. Through the point on the expansion line near the actual cut-off draw a hyperbolic curve. The point where these two lines intersect is to be considered the commercial cut-off point. The percentage of cut-off is often found by dividing the length of the diagram measured to this point by the total length of the diagram and multiplying the result by 100. The commercial cut-off as thus determined is situated at an earlier point of the stroke than the actual cut-off used in computing the steam accounted for by the indicator.

Since this difference necessitates the construction of a hyperbolic curve on the expansion line of the indicator card, it will be interesting to see how this is, as a matter of fact, usually accomplished. According to the rule above given we should begin our curve more properly at the point Q shown on the expansion curve ABC in Fig. 3. For our purposes, however, as the space from there up to the line XF would be somewhat limited we shall begin the construction of our curve at the point B. Let us first assume that the curve XQBJNZ represents the actual indicator diagram taken from test. Parallel to the atmospheric line shown in the diagram we draw the line OY a distance to scale equal to 14.7 lb. below this line, thus drawing the line of absolute zero pressure. We next draw the line ZX extended downward perpendicular to this line and intersecting line OY at the point E and then at the extreme right we draw a perpendicular line

FG intersecting the line OY at G. The distance EG now represents to scale the stroke of the engine cylinder in question. It is next necessary to determine the clearance point O before we can proceed further.

We begin at two points along the expansion QB which are apparently even and characteristic. Looking at this curve we see that the points B and C indicate such a condition. Let us draw the horizontal lines BD and CE and at the points D and E at which the perpendicular lines CD and BE respectively intersect these horizontal lines, we draw the straight line DE. This line is now produced until it intersects the line of zero pressure EG at the point O. The distance OE scaled off will give us the clearance of our cylinder. Several different pairs of points may be similarly taken along the expansion line and the average intersection or the average O on the line of zero pressure EG will be more nearly correct for this point.

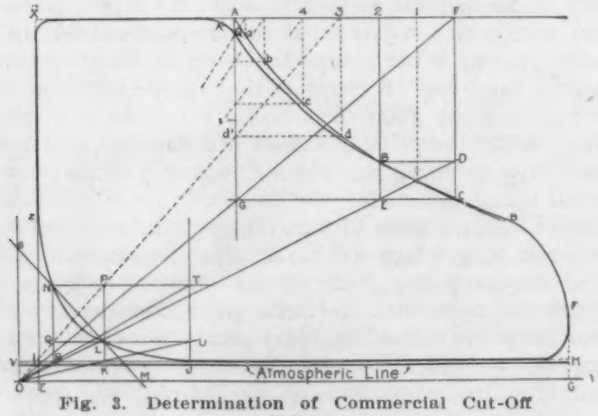

Fig. 3. Determination of Commercial Cut-Off Point.

Engineers have often found still another method of arriving at the location of the point O—in words, at the clearance value—by taking into consideration the compression curve. It is a property of the rectangular hyperbola that a line intersecting the horizontal and perpendicular axes at an angle of 45 degrees cuts off equal segments between the curve and the axes. Acting upon this principle let us draw the line MS so that this line intersects our curve at the points L and N making an angle NMO equal to 45 degrees. According to our law just announced we may now scale the distance LM with our dividers and make NS exactly equal to it. The perpendicular then let fall from S upon the zero pressure line EG will determine for us the point O which we are looking for. Many engineers consider this method more accurate than that of using the expansion line. It is a good plan, however, to utilize both methods in determining this point and then take an average value.

Having now definitely determined the zero point O we now proceed to construct the hyperbolic curve, the ideal expansion line as stated above. In order to meet the requirements of the committee of the American Society of Mechanical Engineers in the determining of the point of cut-off A, we should begin at the point Q on the expansion line. In order, however, to have more room for illustration we begin at the points B and C. As previously set forth the rectangle BDCE is constructed. The verticle line CD is then extended upward until it intersects the admission line XA produced at some point F. The diagonal line FO is then drawn and at the point where CE produced to the left intersects the line FO, the same being the point G, we erect a perpendicular GA. The point A is then the particular point in question for which we are in search; namely, the commercial point of cut-off.

By scaling off the distance XA we can at once determine the distance out from the beginning of the stroke at which the point of cut-off takes place. We can now determine as many intermediate points along this curve as we may desire, for by taking the points 1, 2, 3, 4, etc., along the line FA and connecting these points with the point O we can determine a series of points on the curve. For instance, let us note d', which is the point where the line 30 intersects the vertical line GA. Then by drawing the vertical line 3d and the horizontal line d'd to their point of intersection d we definitely determine this point d which is on our theoretic expansion curve. By an exactly similar method the points a, b, c, and as many others as we may desire are located.

Thermotwisters.

1. In a government test on a marine boiler made with California oil the following data were taken. The analysis of weight of the oil fuel was as follows: Carbon 81.52%; hydrogen 11.01%; sulphur 0.55%; oxygen 6.92%. The analysis of the chimney gases by means of an Orsat apparatus was in volume as follows: Carbon dioxide 6.6%; oxygen 12.6%; carbon monoxide 0.4%; nitrogen 80.4%. The temperature of the boiler room was 96° F., the temperature escaping chimney gases 743° F. and the temperature of the atomizing steam 378° F. The equivalent evaporation from and at 212° F. was 11.19 lb. of water per lb. of fuel oil. Determine the heat balance for the test. Steam used on atomization was 0.644 lb. per lb. of oil.

(a) The heat lost in the flue gases $= 0.24\ W\ (T - t)$

$$W = \frac{c\ (11a + 8b + 7c + 7d)}{3a + 3c}$$

where $c = .8152$, $a = 6.6$, $b = 12.6$, $c = 0.4$, $d = 80.4$, $A = 0$ (no ash for oil.)

$$\therefore\ W \frac{.8152\ (11 \times 6.6 + 8 + 12.6 + 7 \times 0.4 + 7 \times 80.4)}{3 \times 6.6 + 3 \times 0.4} = 28.7$$

$$\therefore\ 0.24\ W\ (T - t) = 0.24 \times 28.7\ (743 - 96) = 4355\ \text{B.t.u.}$$

$$\text{Calorific value of fuel} = 14600\,c + 62{,}000\ \left(H - \frac{0}{8}\right) + 4000S$$

$$= 14600 \times .8152 + 62{,}000\ \left(.1101 - \frac{0692}{8}\right) + 4000 \times .0055$$

$$= 18.202\ \text{B.t.u.}$$

$$\text{Hence lost in flue gases} = \frac{4355}{18{,}202} = 23.9\%.$$

(b) Loss due to moisture formed by burning of hydrogen

$$= (9\,H + W)\ [212.9 - t + 970.4 + 0.48\ t_e - 212)\ ]$$

$$= 9 \times .1101\ [212.9 - 96 + 970.4 + 0.48\ (743 - 212)\ ] = 1330$$

$$\text{Hence in percentage loss} = \frac{1330}{18202} = 7.3\%$$

(c) Loss due to incomplete combustion.

$$c \times \frac{10150\ CO}{CO_2 + CO} = .8125 \times \frac{10150 \times 0.4}{6.6 + 0.4} = 473\ \text{B.t.u.}$$

$$\text{Hence lost in incomplete combustion} = \frac{473}{18{,}202} = 2.6\%.$$

(d) Loss due to superheated steam used in spraying oil.

$$0.48\ W_s\ (T - t_s) = 0.48 \times .644\ (743 - 378) = 113\ \text{B.t.u.}$$

$$\text{Hence in percentage, loss} = \frac{113}{18202} = 0.6\%$$

(3) Stray losses.

Total heat accounted for

$= 4355 + 1330 + 473 + 113 + 10{,}860 = 17131$

$\therefore$ Stray losses $= 18{,}202 - 17131 = 1071$ B.t.u.

Hence in percentage, stray losses $= \frac{1071}{18{,}202} = 5.9\%$.

F. Heat absorbed by boiler.

$= 11.19 \times 970.4 = 10860$ B.t.u.

$\therefore$ efficiency of boiler $= \frac{10{,}860}{18{,}202} = 59.7\%$

CHRONOLOGY OF ILLUMINATION.

BY W. R. MORGAN.

B. C.

1450 First artificial lighting by "fire-pans," "censers" and "metal braiziers,"

1200 Torches used for interior lighting.

500 Oil lamps first used.

238 Earliest mention of coal by the Greek philosopher, Theophrastus.

A. D.

1852 First mention of coal in England; contained in the Saxon Chronicle of the Abbey of Petersborough.

1000 Coal began to replace wood and charcoal.

1180 Coal first mined systematically in England.

1250 Coal became a commercial commodity.

1259 King Henry III granted charter to mine coal in Newcastle.

1272 Coal used in London.

1316 A Royal Proclamation issued forbidding use of coal in London on account of the "noisome smell."

1417 First attempt at street lighting in London. Sir Henry Barton, Mayor, ordained that "lanterns with lights be hanged out on winter evenings, between the hours of Hallowtide and Candlemas."

1500 Bazil Valentine discovered muriatic, sulphuric and nitric acids.

1524 Lanterns used for street lighting in Paris.

1541 About this time Paracelsus discovered hydrogen gas.

1560 Special license granted to make charcoal and smelt iron.

1580 Use of coal prohibited by Queen Elizabeth in London while Parliament was in session, because "the health of the knights of the shires might suffer during their abode in the Metropolis."

1609 Val Helmont settled in Brussels and gave the name of "Gas" (from "Geist," meaning ghost or spirit) to the aeriform bodies produced by combustion and by fermentation.

1645 British Royal Society formed (Constitution adopted 1662).

1659 Thomas Shirley investigated a natural gas well in Lancashire, England, and wrote the first description of experiments with natural gas. (Published in the "Transactions of the Royal Society for June, 1667").

1662 The use of coal become so extensive that the sum of £200,000 was raised by means of a "Hearth Tax" imposed on fireplaces by King Charles III.

1662 Robert Boyle ennunciated that statement known as "Boyle's Law."

1670 Dr. Clayton experimented with natural gas at Lancashire, England, and distilled coal to produce gas which he stored and lighted. An account of his experiments was published in the Transactions of the Royal Society for 1739.

1675 Coal distilled for the production of tar.

1676 Boyle's Law confirmed by Mariotte.

1679 A "coal mine" near Ottawa, Ill., U. S. A., mentioned by Father Hennepin, a Jesuit Missionary.

1697 First street lighting ordinance passed in New York City.

1700 Coal exported from England to European countries.

1726 Dr. Stephen Hales published "Vegetable Statics" describing his experiments on the distillation of coal.

1733 Lanterns used for street lighting in Birmingham.

1749 Coal first mined in Richmond Basin, Virginia, U. S. A.

1754 Dr. Joseph Black discovered carbonic acid gas (carbon dioxide).

1755 Coal discovered in Ohio, U. S. A.

1760 Theory of specific heat and of latent heat propounded by Dr. Joseph Black.

1762 Oil lamps (street lamps) first installed in New York City.

1766 A gold medal offered by the French Academy of Science as a prize for the best essay on street lighting; won by Lavoisier.

1767 Hydrogen discovered in water by Henry Cavendish.

1774 Oxygen discovered by Joseph Priestly.

1775 The composition of atmospheric air discovered by Lavoisier.

1776 The water lute (water seal) invented by Priestly.

1781 A patent granted to the Earl of Dundonald for distilling coal—all the products of distillation are mentioned except gas.

1781 The gas holder invented by Lavoisier.

1781 Jean Pierre Minckelers lighted gas distilled from coal as a demonstration to his class in the University of Louvain.

1784. The composition of water discovered by Cavendish.

1789 A description of Lavoisier's gas holder published in England.

1790 Anthracite coal first mined in Pennsylvania.

1792 William Murdoch distilled coal in an iron retort and conducted the gas seventy feet through tinned iron and copper tubes to light his house and grounds at Redruth in Cornwall.

1797 Murdoch lighted with gas his house and offices at Old Cumnock.

1798 Murdoch lighted with gas one of Boulton & Watt's shops at Soho, near Birmingham.

1799 Murdoch invented the "D" slide valve (used in steam engines and gas meters).

1799 Sept.. Philippe Lebon (in France) patented a "Thermolampe" for the production of gas by distillation from wood, coal, etc.

1801 Ledon lighted with gas his house and gardens in the Rue St Dominique, France.

1802 April Murdoch gave a public display of gas lighting at Soho to celebrate the Peace of Amiens.

1803 Frederick Albert Winsor bagan experimenting with gas apparatus at Hyde Park, London.

1804 Murdoch built gas works and lighted Boulton & Watt's shops at Soho.

1804 May Winsor obtained first English patent for gas-making apparatus.

1804 Winsor gave a public display of gas lighting at the Lyceum Theatre, London.

1805 Matches invented.

1805 Murdoch built gas works and lighted the cotton mill of Messrs. Phillips & Lee at Manchester; nine hundred burners were supplied.

1805 Samuel Clegg built gas works and lighted the cotton mill of Mr. Henry Lodge near Halifax.

1806 Edward Heard patented a process of using lime as a purifier.

1806 David Melville in Newport, Rhode Island, lighted his house with coal gas.

Dec. 1806 Lead pipes laid in Pall Mall, London, by Winsor. These were first gas mains laid in a public street.

Jan. 28.
1807 One side of Pall Mall lighted with gas.
June 12.
1807 Both sides of Pall Mall lighted with gas.
July 12 1807 First meeting of gas stockholders (proposed National Light and Heat Company, London).
Feb. 25 1808 Murdoch read a paper describing the gas installation at Phillips & Lee's Cotton Mill before the Royal Society, and was awarded the Count Rumford Gold Medal.
May 5 1809 Hearing before the House of Commons upon Winsor's application for a charter for the "National Light & Heat Company." He was opposed by Murdoch and Watt.
1809 Clegg wrote a paper on the application of gas lighting to mills and factories and was awarded a silver medal by the Society of Arts.
1809 Wet lime purifier introduced by Clegg in a plant to light Mr. Harris' factory at Coventry.
1810 Application made to Parliament by Winsor and his stockholders to form the "London & Westminster Gas Light & Coke Company."
1810 Act of Incorporation passed by Parliament in favor of the "London & Westminster Gas Light & Coke Company."
April 1812 A Royal Charter granted to the "London & Westminster Gas Light & Coke Company." This was the first gas company formed.
1812 The hydraulic main introduced by Clegg in a plant to light the cotton mills of Ashton Brothers at Hyde.
1813 Clegg became engineer of "The London & Westminster Gas Light & Coke Company."
Mar. 18 1813 David Melville obtained a patent on his apparatus for making coal gas.
Dec. 31 1813 Westminster Bridge lighted with gas for the first time.
April 1814 The oil street lamps of St. Margaret's Parish, Westminster were replaced with gas lamps.
Dec. 9
1815 First gas meter invented by Clegg.
Dec. 28 1815 Gas lighting first proposed for Philadelphia by Mr. James M. Murtie.
1815 First treatise on gas lighting published by Frederick Accum.
1816 Gas lighting introduced in Liverpool, England.
1816 The cylindrical gas holder first appeared. Constructed at the works of the London & Westminster Gas Light & Coke Company under direction of Samuel Clegg.
1816 First Gas Company incorporated in the United States, at Baltimore, Maryland.
1816 Gas lighting first exhibited in Baltimore at Peale's Museum.
1816 Clegg invented the wet meter with revolving drum.
1817 Gas lighting introduced in Manchester, England.
1817 Clegg's wet meter remodelled and improved by John Malam.
1818 Gas lighting introduced in Sheffield, Glasgow and Edinburgh.
June 19 1819 Heard and Gordon obtained a patent for compressing gas in metal drums to furnish a portable supply.
1819 London Portable Gas Company formed.
1819 Gas lighting at Birmingham, Bristol, Paris and Brussels.
1820 Process of Oil Gas Manufacture patented by Taylor and Martineau.
May 1821 Act of Parliament passed, authorizing the erection of Oil Gas Works.
1821-4 Oil Gas Works built at Bristol, Colchester, Dublin, Edinburgh, Hull, Leith, Liverpool, Norwich, Plymouth and Taunton.
1822 Gas Lighting introduced in Munich and Belfast.
1823 Malam patented a process of dry lime purifying.
1823 The Boston (Mass.) Gas Light Company established.
1823 Gas Lighting introduced in New York City.
Jan. 19
1824 Broadmeadow patented the exhauster.
1825 Gas lighting introduced in Amsterdam, Hanover, Ghent, Rotterdam and Rousells.
1825 Governor invented by Samuel Crosley.
1825 New York Gas Light Company established.
1825 Benzole discovered by Faraday.
1825 First gas lamps erected in Brooklyn, New York.
1827 Gas Lighting in Berlin.
1828 First Gas Works in Boston, Mass., built on Hull St.
Jan. 1
1829 First gas lamps in Boston lighted in Dock Square.
1829 Gas lighting introduced in Dresden.
1830 Manhattan Gas Light Company established in New York.
1832 Meters first manufactured in the United States by Samuel Hill in Baltimore, Maryland.
1832 Gas lighting introduced in Louisville, Kentucky.
Mar. 19 1833 A dry meter invented by James Bogardus, an American engraver, was patented by Miles Berry.
1833 Gas lighting introduced in Vienna.
1833 Gas lighting introduced in New Orleans, Louisiana.
Oct. 12 1833 The telescopic holder patented by Hutchinson, engineer of the London Metropolitan Gas Company. This holder was invented in 1824 and described in Creighton's Encyclopedia.
1834 Gas lighting introduced in Havre.
1835 Gas meters manufactured in New York by Young and in 1836 by Samuel Down.
1835 Gas lighting introduced in Caen, Amiens, Bologna, Lyons and St. Petersburg.
1836 Gas lighting introduced in Philadelphia, Pennsylvania, and in Pittsburgh, Pennsylvania.
1838 Gas Lighting introduced in Nantes and in Leipsic.
1840 Gas lighting introduced in Cincinnati, Ohio and in Montreal, Canada.
1840 Meters adopted by the London & Westminster Gas Light & Coke Company.
1841 Gas lighting introduced in Manchester, New Hampshire; and in Sydney, Australia.
1842 Gas lighting introduced in Toronto, Canada.
1843 Gas lighting introduced in Halifax, Nova Scotia.
1843 William Richards made a dry meter with two diaphragms, two slide valves, and a dial, which with minor improvements is the meter in use today.
1844 Gas lighting introduced in Hamburg.
1845 Gas lighting introduced in Madrid.
1846 Gas meters made legal in France.
1846 Gas lighting introduced in St. Louis, Missouri.
1847 Gas lighting introduced in Breslau, Germany; Fall River, Massachusetts, and Newark, New Jersey.
1848. New Haven City. Lighted.
Patterson, N. J. Lighted.
Providence, R. I. Lighted.
Rochester, N. Y. Lighted.
Buffalo, N. Y. Lighted.
Washington, D. C. Lighted.
1849 Quebec, Canada. Lighted.
Norfolk, Va. Lighted
Cleveland, Ohio. Lighted.
Detroit, Michigan. Lighted.
Syracuse, N. Y. Lighted.
Utica, N. Y. Lighted.
1849 A company formed in Boston, Mass., by Mr. George Darracott to manufacture meters.

1850 Chicago, Illinois. Lighted.
Columbus, Ohio. Lighted.
Hartford, Conn. Lighted.
Worcester, Mass. Lighted.
Kingston. Lighted.
1851 Hamilton. Lighted.
Indianapolis, Indiana. Lighted.
Memphis, Tennessee. Lighted.
Buenos Ayres, Argentine Republic. Lighted.
1833 Brockville. Lighted.
Rome. Lighted.
Heidelberg. Lighted.
Milwaukee, Wisconsin. Lighted.
1854 Belleville. Lighted.
Nice. Lighted.
St. Joseph, Missouri. Lighted.
San Francisco, California. Lighted.
Toledo, Ohio. Lighted.
Ottawa, Canada. Lighted.
1855 Vera Cruz. Lighted.
1856 Atlanta, Ga. Lighted.
Melbourne. Lighted.
Warsaw. Lighted.
1857 Scranton, Pa. Lighted.
St. Paul, Minnesota. Lighted.
Copenhagen. Lighted.
1858 Tasmania. Lighted.
1860 Portland, Oregon. Lighted.
1861 Malta. Lighted.
1862 Shanghai. Lighted.
Hong Kong. Lighted.
1863 Smyrna. Lighted.
1864 Alexandria. Lighted.
1865 Bombay. Lighted.
Rio Janiero. Lighted.
Christchurch. Lighted.
1866 Corea. Lighted.
1867 Moscow. Lighted.
Kansas City, Missouri. Lighted.
Los Angeles, California. Lighted.
Oakland, California. Lighted.
1868 Ceylon. Lighted.
Omaha, Nebraska. Lighted.
1869 Stockton, California. Lighted.
1870 Leeds. Lighted.
1871 Yokohama. Lighted.
Minneapolis, Minnesota. Lighted.
1872 Tokyo. Lighted.
Montevideo. Lighted.
1873 Seattle, Washington. Lighted.
1878 Cologne. Lighted.
1879 St. Johns. Lighted.
1885 Tacoma, Washington. Lighted.
1887 Spokane, Washington. Lighted.

TRAIN DISPATCHING BY TELEPHONE.

The appropriations now being prepared in Winnipeg for the work of the Canadian Pacific Railway during 1912 will contain an item for the installation of over 1000 miles of telephone circuits. Such systems have already been successfully used on railroads in the United States, and Canadian tests of the telephone for train dispatching have also proved successful. It will not be long therefore before this method will be used over the entire system of the Canadian Pacific Railway. Almost all the new circuits will be built west of Fort William, the work of equipping the main lines in the east having been virtually completed.

THE INTERNATIONAL ENGINEERING CONGRESS.

To formulate plans for holding an international congress of engineers at San Francisco during the Panama Pacific Exposition in 1915 twenty-seven delegates from nine engineering societies met at the Exposition Building on January 15. At this meeting it was unanimously decided to hold such a meeting and a representative committee was selected to take charge. W. F. Durand, professor of mechanical engineering at Stanford University, was chosen as chairman and Otto Von Geldern as secretary, the other members being H. A. Lardner, C. D. Marx, C. B. Wing, Geo. W. Dickey, S. B. Christy and F. W. Bradley.

The most definite assurance of support was received from the American Institute of Electrical Engineers, whose delegates, H. A. Lardner, George Murphy and S. J. Lisberger, reported that the International Electro-Technical Commission had granted authority to hold an International Electrical Congress in San Francisco during the month of September, 1915, the official meeting of the Commission to be held about the same time. This arrangement will, of course, preclude the American Institute of Electrical Engineers from merging or combining these congresses into a general engineering congress. However, it is greatly interested in this meeting and will do all in its power to co-operate in the arrangements.

The American Society of Mechanical Engineers was represented by Calvin W. Rice, the national secretary; W. F. Durand and E. C. Jones, and assured its hearty co-operation in this work.

The committee from the American Society of Civil Engineers, consisting of A. D. Foote, C. D. Marx and W. A. Cattell, has not yet received definite instructions from the parent society, nor has the American Institute of Mining Engineers nor the Mining and Metallurgical Society.

The Pacific Coast Gas Association, represented by John A. Britton, C. O. G. Miller and Frank A. Leach, Jr., stated that a national meeting of the gas engineers had been arranged. The other organizations, including the American Society for Testing Matereials, Society of Naval Architects and Marine Engineers and Technical Society of the Pacific Coast, have given the matter favorable consideration but have not yet taken definite action.

THE BEE AS AN ENGINEER.

In the construction of the hexagon honey cells of material from her own body, the working bee at once has solved the problem of economy of room, of the lightest possible material of greatest strength, while the dividing wall in each honey case allows the greatest number of workers to continue "on the job." Strips of comb a foot wide and four feet long sustain a weight of thirty or forty pounds of honey, while the comb itself would probably not weigh more than five or six ounces,

ELECTRIC SIGNS IN PARAGUAY.

Electric signs are not needed in Asuncion, Paraguay. Consul Ferris states that the streets are deserted after 7 p. m., and the shop windows are closed by heavy iron shutters.

THE MAN-AND-A-WHEELBARROW.

Ninety-five per cent of the water power locations in the State of California are not made in good faith, nor with the intention of developing energy, according to a statement made recently by Horace T. Jones, special agent for the Conservation Commission and the Conservation Board of Water Power Control. Our own views on this subject may be found on the editorial page, but for the edification of our readers we publish an abstract from Mr. Jones' report.

More than 3000 water power locations have been investigated by the Commission and Board. It is held that valuable water power sites are being held by the "man-and-a-wheelbarrow" method, and as a consequence development of the power resources of the State are retarded.

Filings are made, according to Jones, for the sole purpose of speculation. The locators of power sit on the locations and wait for some company or interest to come along, and then they cinch the victim, who is out for power with the intention of developing it and turning it into commercial uses.

"Development consists largely," said Jones, "of trails and cabins built and surveys. Everything is done by the speculator in water rights that can be done easily and without much outlay.

"The usual custom is to have one or two men, with a wheelbarrow or a pick and shovel, stay on the ground until it can be ascertained whether or not there is any likelihood of a big company or interest coming on to the ground and buying the right, such as it is.

"This is the case in a large number of the filings located at strategic points along the Tuolumne river and its tributaries, for which the purchase price of $652,000 was paid partly to acquire certain water rights belonging to the Ham Hall interests, to control the San Francisco water rights, and also for certain reservoir and dam sites on the upper Tuolumne and the upper tributaries of that stream.

"It was for the purpose of avoiding the difficulty presented to the city of San Francisco that the 'Glavis-Pardee' conservation bill was introduced in the Legislature at the extraordinary session. By this bill the Board of Control of Water Power would have been authorized to sit as a quasi-judicial body to pass upon and adjudicate the use of waters on the various streams of the State."

COAL PRODUCTION OF THE UNITED STATES

Although the production of coal in the United States during 1911 was probably second only to that of the record year, 1910, the year was unsatisfactory to the coal-mining industry. Overproduction and the struggle for trade depressed prices heavily. The record of the anthracite region of Pennsylvania was a notable exception to the general conditions. The shipments of anthracite for the 11 months ended November 30 amounted to 63,838,872 long tons, and the December shipments are estimated at 6,250,000 long tons. This total exceeds the previous high record of 1907 by approximately 3,000,000 tons. The local trade in 1911 amounted to about 2,000,000 long tons, and the colliery consumption to 8,000,000 tons, making the total production for the year close to 80,100,000 long tons, about 4,700,000 long tons over the 1910 output. A part of the increase in production is probably due to the stocking of fuel in anticipation of April 1, 1912, when the present wage agreements terminate, but the market has been absorbing an unusually large tonnage, and the increase is not chiefly artificial.

Much of the bituminous business has been conducted at a loss, and the trade as a whole has been demoralized. The depression of the iron trade has been seriously reflected in the coking-coal regions. It is estimated that the production of coke in 1911 will show a decrease of 20 to 30 per cent from that of 1910. The shutting down of hundreds of coke ovens has added the burden of disposing of a large part of the slack usually consumed by that industry to the other troubles of the bituminous operators.

The total production of bituminous coal in 1911 was probably 3 to 5 per cent below that of 1910. A decrease of 5 per cent means a decline of 25,000,000 short tons, or more than the total coal production of Belgium, the sixth coal-producing country of the world. With this decrease the bituminous output for the year would be between 395,000,000 and 405,000,000 short tons. With the addition of the total anthracite output, the total production of coal for 1911 aggregates between 485,000,000 and 496,000,000 short tons, compared with 501,600,000 short tons in 1910. These estimates are based on statements from leading operators, on the railroad shipments for all but the last few weeks of the year, and on the monthly reports from the blast furnaces.

POWER FROM GARBAGE IN EUROPE.

The generation of electric power from the combustion of garbage on the continent of Europe has been less successful than in England. In general the plants employed are different, the Germans, for instance, using forced draft of 300 to 600 m.m. of water, instead of 60 to 100, as in England. Grates of the bar variety are not used, but troughs into which the material is dumped and through holes in the sides of which the air is blown. Such plants have been built at Wiesbaden, Mickolez, Kiel, Brunn and Frankfort. Continuous grates, however, have been used at Paris, Ixelles, Havre and Rouen, while installations of this kind are under construction at Rotterdam. In plants at St. Petersburg, Zurich and Furth automatic devices for charging the furnaces are used. The new continental plants are designed with a view to power production, the usual guarantee being one pound of steam per pound of refuse. Data regarding some continental plants follows:

Frankfort, six horizontal water tube boilers having 750 square meters of heating surface furnish steam to two 500 h.p. engines, which generated 2,290,143 kw. h., of which the plant itself consumed 377,039, municipal lines used 984,316 kw. h., and the water works plant 928,788 kw. h. Barmen, three vertical fire tube boilers having 420 square meters heating surface, which furnish steam to one 600 h.p. engine, generating 1,400,000 kw. h., of which 300,000 was consumed at the plant, the balance by municipal electric systems. Brunn, two horizontal water tube boilers having 424 square meters heating surface, which furnish steam to two

boilers of 675 h.p.; 809,062 kw. h. were generated, of which 138,615 were consumed by the plant, the balance by the municipal electric system. Frederiksberg, three horizontal water tube boilers having 615 square meters heating surface, which supplies steam to two engines of 340 h.p.; 496,187 kw. h. were generated, of which 193,885 were consumed by the plant, 120,869 by the municipal hospital, 2,919 by the water system and 125,514 for private lighting. Zurich, three horizontal water tube boilers of 410 square meters heating surface, which supplied steam to one 220 h.p. engine; 180,347 kw. h. were generated, of which 130,751 was consumed by the plant and 49,596 by shops. At Kiel there are three horizontal water tube boilers having 510 square meters of heating surface, which supply steam to one 80 hp. engine.

GAS AND ELECTRIC EARNINGS IN THE LEAD

Henry L. Doherty & Co., of New York, has issued a chart and tables showing the relative increases and decreases of the earnings of the steam railroads, electric lines, gas and electric companies and industrial corporations from 1902 to 1910.

These data show that the gross and net earnings from the gas and electric business increased the more rapidly, and that they were practically unaffected in their rate of increase by the panic conditions, even in 1907 and 1908. Gas and electric properties, in the eight years under review, experienced no decrease in net earnings, while the gas and electric and street railway properties are the only ones which showed no decrease in gross earnings. The earnings of the railways and industrials, on the other hand, were subject to the most violent fluctuations, falling very rapidly in the years of panic and depression—1903-4 and 1907-8.

It is noted that the rate of increase in gross earnings of gas and electric companies, was less in 1908 than in any of the other years under review, but net earnings were unaffected. The Doherty deduction and explanation is that this slacking off was due to the fact that many managers of lighting plants, frightened by the panic curtailed their business getting expenditures in that period. In this they erred. It is also declared that earnings of steam railroads and industrials fluctuate in common, owing to their dependence upon freight movement and industrial conditions, hard times forcing drastic economies in purchases of maintenance supplies, while electric railways derive almost all their revenue from passenger travel, which with them is very little affected in times of stress.

Another feature worthy of note in this interesting comparison is that the gross earnings of all properties under review have shown a greater percentage of increase than that of the net earnings. Probably this is due largely to the fact that the cost of materials, or labor or both, have increased more rapidly than prices have enhanced. This is particularly interesting, in view of the general downward trend of prices for gas and electric service in the last ten years. The net profits are seemingly coming from a constant increase in the volume of sales, rather than, as formerly, from small sales and larger profits.

POWER FROM LAKE GENEVA.

Two suggestions have been made for exploiting the Lake of Geneva for the benefit of Paris, one being to convey its water through an aqueduct to Paris and the other to utilize the water power of the upper Rhone at its outflow from the lake.

According to the latter it is proposed to build a huge embankment at Genissiat, which is to convert the whole valley of the upper Rhone as far as Geneva into an artificial lake 23 kilometers long, with a capacity of 50,000,000 cubic meters. The head of 67-69 meters thus available would supply up to 246,500 kilowatts, while the number of kilowatt hours available during a year would be equivalent to the energy supplied by the combustion of 1,500,000 tons of coal. The power house at the foot of the embankment is to contain 24 units of 10,000 kilowatts or 16 of 15,000 kilowatts, and three-phase transmission at 120,000 volts (possibly 150,000 volts) is to be adopted, the current being generated at 12,000 volts and transformed up in a transformer house about 80 feet long. The Francis turbines are to work at a speed of 250 revolutions per minute, and the continuous current exciter machines (750 kilowatts, 160 volts) are to be operated by vertical turbines. Each turbo-generator set is to be quite self-contained. The four high-tension transmission lines from Genissiat to Paris are to convey no less than 80,000 to 100,000 kilowatts. They are to be divided into two groups, following different paths, each line to be subdivided by section switches into sections of 100-kilometers each, transverse lines permitting any injured section to be cut out without interfering with the operation of the plant. They are to consist of aluminum lines arranged 10 feet apart and carried by steel towers 65 feet in height. A thick galvanized steel protective wire is to run on top of the lines.

OIL PRODUCTION OF CALIFORNIA.

The total oil production of the State of California for 1911 was 78,845,082 barrels, according to figures just compiled by R. W. Dallas, manager of the California branch of the Independent Oil Producers' Agency. This is an increase over 1910 of 5,834,522 barrels, or about 8 per cent. The total production for 1910 was 73,010,560 barrels. Midway field leads with a production of 20,000,000 barrels, and Coalinga comes second.

TAMPICO, MEXICO, ELECTRIC ACTIVITY.

Plans are said to have been completed for replacing the mule cars with electric cars, for enlarging one of the electric-light plants, and for utilizing the water power of the rivers of this region for electric power.

The stability of the new administration in Mexico is adding wonderfully in the restoration of confidence in all quarters. Throughout the republic hydroelectric enterprizes are being promoted and the reopening of long-closed mining operations is of material aid in assuring the consumption of electrical power.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE

Technical Publishing Company

Rialto Building, San Francisco

E. B. STRONG, President and General Manager
A. H. HALLORAN, V. P. and Managing Editor
ROBERT SIBLEY, Treasurer and Editor in Chief
C. L. CORY, Secretary and Special Contributor
A. M. HUNT, Director and Special Contributor

On Library Cars of all Southern Pacific Trains.

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.25

NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas." Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

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Chronology of Illumination

Since the beginning of creation man has yearned and longed for the light. Down through the ages beginning with those early days of which we read that "Darkness was upon the face of the deep and the spirit of God moved upon the waters and God said 'let there be light,'" man has steadfastly yearned and longed for its complete fulfillment. The instinctive desire of the new-born babe to turn its eyes toward the glistening ray which perchance throws itself across the darkened bed-chamber is the most striking example of this human trait.

Even the most dissolute of human beings have felt its charms and we can almost imagine that the ruling passion uppermost in the thoughts of the degenerate old Roman Emperor, Nero, as he quietly fiddled away in the presence of the burning of Rome which he himself had planned, was not that of "There'll be a hot time in the old town tonight," but rather that inborn something, that something which moves us all no matter how low we may have fallen, namely "search for the light."

We of modern times can scarcely realize what the advance of ingenuity and invention has done for the solution of this burning question of the ages. As, in the evening we enter the brilliantly lighted metropolis every street with its well designed electrolier or Welsbach, every ballroom with its glittering bespangled decorations should forcefully contrast itself with the dingy, crime-lurking streets of the days of yore and with the ballroom of yesterday suggestive more of spooks than the fairy-winged beauties of today.

Elsewhere in these columns is to be found a chronology of illumination by W. R. Morgan which sets forth the interesting facts or mile posts, as it were, in the advance of the art of illumination. Most striking is the contrast of the slow progress in the art for centuries upon centuries as compared with that of the past two decades. Even the far famed "ten league boots" could not follow the recent comet-like progress of this art across the horizon of human progress.

The human race, like the philosopher of old with his lantern lighted in broad daylight, is ever yearning to be raised to a higher plane, and though its efforts may be as futile as those of Diogenes in his search for an honest man, yet the very symbolism of light itself so forcefully emphasized by the modern improvement in illumination is unquestionably working upon the unconscious psychological side of man a deep felt influence.

Oil Burners

The subject of oil burners has been one of considerable agitation of late both in the columns of this Journal and elsewhere. In this issue will be found an article on "Drilling Boilers in the California Oil Fields," and in its conclusion the author, A .S. Menzin, has given interesting details of a home-made burner which seems to have considerable popularity in the oil producing localities of the State.

The remarkable efficiency with which such crude mechanisms perform their purpose proves more thor-

oughly the idea now so well recognized among engineers, that after all the question of the burner is not one of paramount importance. The actual setting of the boiler and particularly the arrangement of the furnace with its baffling walls seem to be the crucial points in deciding the efficiency or non-efficiency of installations of this sort.

Not many months ago the readers of this Journal were treated to the interesting details of a test on the Parker boilers installed in the Fruitville Plant of the Southern Pacific Company. These boilers showed under a most rigid test the remarkable efficiency of 83.7 per cent. It is the usual practice to neglect in the compilation of boiler efficiency the heat stored in the steam used for the atomization of the oil and also the heat required to superheat this steam to the temperature of the out-going chimney gases. In a word, the efficiency of the boiler is generally taken from the standpoint of evaporative proficiency rather than the net result after allowing for this energy used in the atomization of the oil.

Four boilers of the Parker type have just been installed and put in operation at Station C of the Pacific Gas & Electric Company in Oakland. These boilers are to be used to operate a recently installed 12,000 kilowatt Curtis turbine. It is planned within the near future to subject the entire boiler and turbine installation to the most rigid tests. Hitherto but a single boiler has been tested in trials of this sort, but in the proposed run the plant as a whole will be put through the ordeal.

Engineers are looking forward with much expectancy to the results that may be brought out in this test. Undoubtedly it will add much to our knowledge in this phase of engineering on the Coast. It will be interesting to follow the working of the complete power plant, and especially to note the question, not only of the boiler evaporation, but also the efficiency of the entire plant, taking into account every loss which we are able to completely determine.

At Station A of the Pacific Gas & Electric Company in San Francisco has been recently installed the largest turbo-generator on the Coast. This generator has a capacity of 15,000 kilowatts and is of the Curtis type, with six stages of steam expansion. The test upon this installation will also be of much practical importance for Coast conditions. It will be interesting to note the economy of such large units. The operation of units of this magnitude upon the gigantic network of hydroelectric installations of the Pacific Gas & Electric Company will also be of much interest and undoubtedly there will be developed in the forthcoming test some new and interesting ideas.

The Man-and-a-Wheelbarrow

"The Man-and-a-Wheelbarrow," the title of an article appearing elsewhere in these columns, strikes once again at the hardy prospector who has done so much for the development of our great Western empire. It is indeed true that the locator of a valuable water right often is unable to do more than improve his project by the wheelbarrow method. Only he who has lived in the cabins of the prospector, where either mining or hydroelectric development of our unknown natural resources was being undertaken, can appreciate what the rugged life and stay-with-it-ive qualities of this type of citizen really are.

It is stated in the article above referred to that 95 per cent of the hydroelectric power sites are never actually undertaken. Undoubtedly it might with truth be said that 99 per cent of the mining prospects are never actually developed and yet the history of mining bears record to the fact that only through years of toil on the part of the prospector have many of our great mining projects ultimately succeeded. No one knows of the days of weariness and discouragement, yet unceasing efforts of this class of men.

It is true that if some kind god would drop down from heaven, create the market for power, bring the money for its development and all the other accessories necessary for the complete project, it would be idle for us for a minute to defend the prospector in his work. Human conditions are such, however, that the prospector who through the sweat of his brow climbs over the mountains, runs down his power site, stays with it year after year in the face of every adverse circumstance is entitled to be rewarded for his service in sufficient amount to give him a life competency.

From childhood we have learned that "the mills of the gods grind slow, and exceedingly small." The progress of invention, the history of mining, and above all, hydroelectric development are monuments to the truth of this ancient adage. We turn to the records of the patent office and find a million patents have been issued. Yet patents that are commercially possible only run into the thousands. Should we then because of this small showing, announce to the world that ninety-five per cent of the inventors are not working in good faith? Again, we turn to the mining records and here locations are made literally by the millions. We go out into the mineral districts and find hills gophered from end to end by these so-called speculative prospectors, and yet the number of paying mines but runs into the hundreds. Must we, then, condemn this great body of industrious mining prospectors and say to them, though they have grown gray-haired in their fruitless industry, that ninety-nine per cent are not acting in good faith? Finally, we turn to the water power locator. The record of our western states show volumes of applications and yet the two decades of hydroelectric advance have witnessed scarcely a hundred large water power plants. Shall we then say to the water power prospectors who have spent years of search in a wilderness of mountains, wandering over foot-blistering rocks and dizzy cliffs that because years must still elapse before a nation's development can justify a reward for a life of earnest endeavor, they must now be classed as not acting in good faith?

No, brothers, rest soft and low. Though upstarts of misunderstandings, jealousies and muckraking may apparently dim your chances, the all powerful force of justice will eventally bring sure reward.

PERSONALS.

B. F. Kierulff of Los Angeles was a recent San Francisco visitor.

C. L. Cory has returned to his San Francisco office from a Northwestern trip.

F. B. Gleason of the Western Electric Company was at Los Angeles during the past week.

W. D. Thomas, who is in the electrical supply business at Petaluma, was a recent San Francisco visitor.

Fred L. Webster, Pacific Coast manager for the Allis-Chalmers Company, is visiting the Seattle office.

J. A. Herr, representing the Sprague Electric Company, left during the past week for Southern California.

W. A. Doble, former head of the Abner Doble Company, is now chief engineer of the Pelton Water Wheel Company.

J. A. Ulmer, head of the J. A. Ulmer Machinery Company, arrived at San Francisco from Porterville during the past week.

A. C. Balch, general manager of the Pacific Light & Power Company of Los Angeles, was a recent arrival at San Francisco.

M. F. Steel, of the Benjamin Electric Company's Pacific Coast agency, is in Southern California on an extended selling trip.

John Coffee Hays, general manager of the Mt. Whitney Power Company, with headquarters at Visalia, is at San Francisco.

C. O. Poole, of the electrical engineering firm of Manifold & Poole, with offices at Los Angeles, has been spending a few days at San Francisco.

Ray M. Hart, of Coeur d'Alene, Idaho, who is connected with the construction and operation of electric traction lines in Idaho and Washington, is at San Francisco.

A. E. Barlow, who represents the American Ever-Ready Company in the Pacific Northwest, with headquarters at Seattle, spent the past week at San Francisco.

H. L. Jackman, general manager of the Western States Gas & Electric Company, with headquarters at Eureka, has arrived at San Francisco, after completing an Eastern trip.

F. A. Somers, of the sales force of the Westinghouse Electric & Manufacturing Company's San Francisco office, is traveling through the interior of the State of California.

A. J. Wishon, general manager of the San Joaquin Light & Power Corporations, has arrived at San Francisco from Fresno, accompanied by his assistant, E. B. Walthall.

H. E. Sanderson, the newly appointed Jovian Statesman for Northern California, is expected to do a great deal of much-needed "boosting" for the order this year.

R. F. Oakes, president of the American Ever-Ready Company, has returned to factory No. 8, at San Francisco, after visiting Los Angeles, where the company has a branch.

Ralph Bennett, who has been connected with the engineering staff of the Great Western Power Company for some time, has gone to Los Angeles, where he will maintain headquarters in the future.

H. C. Goldrick, Pacific Coast manager for the Kellogg Switchboard & Supply Company, of Chicago, has returned to San Francisco after a successful business tour of Southern California.

M. H. French of Los Angeles, who has the contract for the transmission line construction of the Southern Sierra Power Company, was a recent San Francisco visitor en route to Butte, Montana.

Thomas I. Stacey, vice-president of the Electric Appliance Company of Chicago, has just arrived at San Francisco after visiting C. C. Hillis, manager of the company's San Francisco branch. Mr. Stacey will make a tour of the Hawaiian Islands.

John S. Eastwood, consulting engineer, has returned to San Francisco from Oregon .

Samuel L. Napthally, general manager of the Great Western Power Company, has returned to San Francisco from Portland.

Elgin O. Stoddard of C. C. Moore & Co. has returned from Honolulu, where he went in connection with securing a big electric pumping equipment contract for the Pearl Harbor drydock.

E. J. Dwyer, who has been manager of the Holabird Electric Company, of Seattle, for several years past, has just come to San Francisco and joined the sales corps of the Holabird-Reynolds Company.

Frank Marcy, who was formerly district manager for the Allis-Chalmers Company at Salt Lake City, and who is now holding a similar position at the same place with the Mine & Smelter Company, is a San Francisco visitor.

Bion J. Arnold, the Eastern traction expert, arrived at San Francisco during the past week, with a corps of assistants who will collect data, and begin his investigations into the city's street railway problems. His remuneration is to be $250 a day.

Hamilton F. Gronen, chief engineer of the Nisqually power plant, is in Milwaukee inspecting and making tests on the 8,000-h.p. turbines and generators for the City of Tacoma's light plant. The turbines and generators are being built at the West Allis shops of the Allis-Chalmers Company.

Elam Miller, commercial engineer for the Pacific Telephone and Telegraph Company, who resigned in order to accept a position with the American Telephone and Telegraph Company, has gone to New York to assume his duties. C. P. Morrill, commercial supervisor for the first-named company at San Francsco, has been promoted to fill the vacancy.

A. I. E. E. MEETING NOTICES.

At the January 16th meeting of the Portland Section, A. I. E. E., J. R. Thompson presented a paper entitled "When Does It Pay to Develop Water Power?"

The San Francisco Section, A. I. E. E., will meet at 8 p. m. on January 26th at the Home Telephone Company's building, where Otto A. Falch, engineer with the Sierra and San Francisco Power Company, will present a paper on the "Design of High-Tension Transmission Lines."

The Los Angeles Section, A. I. E. E., will hold its February meeting on the second or third Tuesday of the month and will discuss papers on "Oil Gas Manufacture," by D. J. Young, superintendent of manufacture for the Los Angeles Gas and Electric Corporation, and "Gas Producer Plants," by O. S. Ensign of the United States Reclamation Service.

ELECTRICAL LEAGUE AT LOS ANGELES.

At the Electrical Lunch Club at Los Angeles on January 11th a new organization was perfected and the name changed to the Electrical League. New by-laws and rules were presented for adoption and it was decided to hold weekly meetings instead of monthly meetings. More complete details will be published later.

PACIFIC COAST A. I. E. E. CONVENTION.

The executive committee of the Portland Section of the American Institute of Electrical Engineers has decided to hold the Pacific Coast convention April 16th to 20th, inclusive, and has also decided upon the Hotel Multnomah as the headquarters.

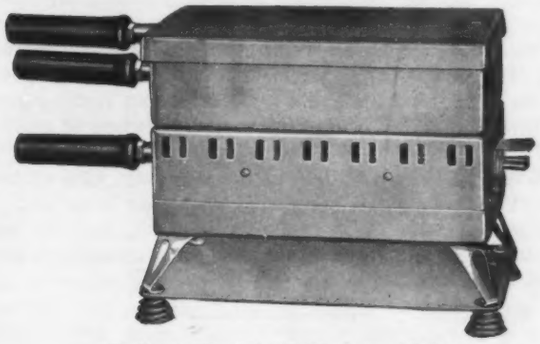
INDUSTRIAL

RADIANT GRILL.

The General Electric radiant grill provides one of the most flexible and useful cooking devices ever designed for the table, nursery or sick-room or for us wherever desired, within reach of a lamp socket. It can be used for toasting, broiling, frying and boiling.

In toasting, the slices of bread may be placed either above or below the radiant heater coil of Calorite wire. Protective gratings on both sides of the heater coil prevent the substance cooked from coming in contact with the coil.

The lowermost receptacle is the broiler pan. This is provided with a corrugated metal rack, the design of which per-



Radiant Electric Grill Assembled.

mits of the steady regulation of the distance of the food from the heater coil. The rack lies on the bottom of the broiler pan; in one position it holds the food away from the heater coil, and by simply turning the rack over, the food is brought closer to the coil.

The uppermost receptacle is the stew pan, which is provided with a cover which can be turned over and used as a frying pan or a griddle. This cover is made of aluminum and therefore does not require the use of grease for making pancakes.

Radiant Grill Showing Parts.

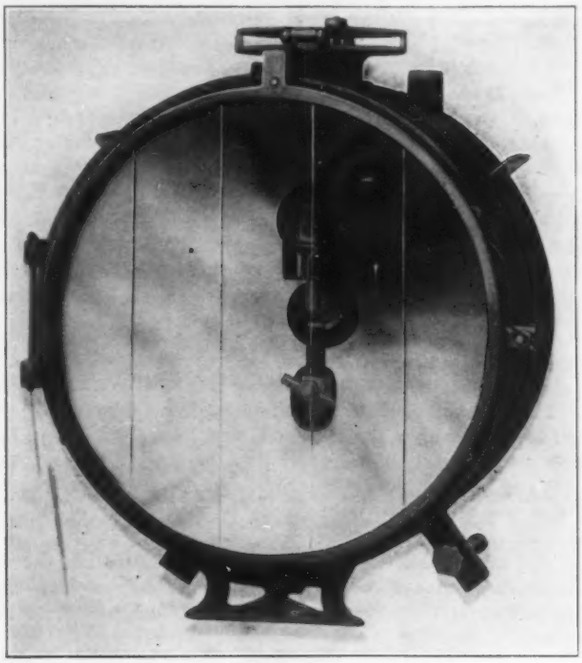
The top of the stove containing the heater coil is hinged to the broiler pan. The hinges are of special design—permitting easy access to the pan below, or allowing the top of the stove to be entirely removed from off the broiler pan for the convenient handling of the latter.

The entire device is finished in polished nickel and its neat appearance makes it a pleasing addition to the table, while its capacity of 600 watts adapts it for use on the ordinary lighting circuit. A specially important feature is the ease with which it can be kept clean.

METALLIC FLAME ARC HEADLIGHTS.

The rapid growth of the use of metallic flame arc lamps has led to their adoption in another field formerly served by the carbon lamps exclusively, that of headlights on interurban electric cars. Such cars require a thoroughly reliable source giving a large volume of penetrating light. These characteristics coupled with great economy of operation are possessed to a marked degree by the metallic flame arc headlights now being put on the market by the Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa.

An additional advantageous feature of these lamps is the fact that by reversing the direction of current through the electrodes by means of the plugs a dim greenish light is obtained which is suitable for use when the car is traversing city streets



Improved Headlight.

Metallic flame arcs give much more light for the same expenditure of energy than do either carbon arcs or incandescents and furthermore the light emitted is very penetrating thus adapting them particularly for headlight service.

The lamps are designed for use only on direct current circuits, the voltage of which is above 120. They take 4 amperes and approximately 70 volts at the arc.

To reduce the line voltage to that required at the lamp terminals, and also for the purpose of steadying the arc, there is supplied a resistor consisting of grooved porcelain spools, around which a special wire is wound, all closed in a readily removable case. The wire is made of a non-corrosive alloy that will not be affected by continual changes in temperature, and the resistance is such that it can be readily adjusted to give the proper voltage at the lamp terminals with a range of line voltage from 325 to 600.

Essentially, the metallic flame arc headlight consists of a simple, rugged feeding mechanism (enclosed within a weatherproof case) arranged to so feed a metallic electrode that it will maintain a steady arc. Sheet iron is used in forming the body of the case, and the case rim and the door frame are brass castings. A hooded chimney is provided at the top, and a hinged door at the bottom for inserting the negative electrode. Supporting brackets, provided with hooks, fasten the headlight to a car dashboard. The hooks engage over a loop of strap metal, which should be provided on the dashboard of the car or they may hang on the upper edge of the dashboard. Two adjusting screws, which have rubber-

covered bumpers arranged to bear against the dashboard, are attached to extensions at the bottom of the case. These are used for properly directing the beam of light.

The glass front consists either of flat sections, in which case a parabolic reflector of spun brass, heavily nickeled and highly polished, is furnished, or of a semaphore lens. In both styles the rays projected from the headlight are parallel.

A feeding mechanism of the simplest possible design has been developed for this headlight. It consists of a solenoid with its winding in series with the arc, which, through a positively acting clutch and a series of levers, feeds the electrode. The lower or negative electrode is attached to a lever and is drawn toward or away from the stationary positive electrode by the movement of the solenoid and clutch. The clutch engages an auxiliary rod attached to an operating lever. No dashpot is required. By turning a screw, the arc length can be adjusted.

The electrodes are similar in composition to those used in Westinghouse multiple and multiple-series metallic arc lamps. The negative one is about 5 inches long and ½ inch in diameter and is composed of certain metallic oxides. The positive one is a metallic block. Negative electrodes have a life of 70 to 80 hours and the positive electrode will last about 500 hours. They can be changed without removing the mechanism from the case.

A particularly efficient application of this lamp is its installation on steam locomotives when used in connection with the small turbo-generators train sets.

NEW BENJAMIN LAMP GRIP.

The Benjamin Electric Manufacturing Company of Chicago is placing upon the market a new device which will play an important part in the prevention of lamp breakage, accidents and general inconvenience due to the loosening of lamps in places where there is any considerable vibration, such as factories, steam cars, street cars, shops, etc.

The device consists of a spring collar, operating through slots in the threaded socket shell and engaging the lamp base with sufficient force to prevent it from loosening and falling out.

New Benjamin Spring Collar.

Its advantages are apparent. It prevents lights from going out unnecessarily, saves time in readjusting them when they work loose, as is often the case during the day; also prevents accidents in dangerous quarters where the lamp might strike the workmen.

The company is prepared to supply this lamp grip with its entire line of reflector sockets covering the range of lamps from 25 to 500-watt, and is now adapting it to its other lighting units.

PELTON-DOBLE COMBINATION.

An announcement of interest to the engineering world is that of the absorption by the Pelton Water Wheel Company, of San Francisco and New York, of the entire rights, including patents, goodwill, patterns, etc., of the Doble water wheel business, formerly conducted by the Abner Doble Company of San Francisco.

W. A. Doble, former head of the Abner Doble Company, goes to the Pelton Water Wheel Company as its chief engineer, vice Geo. J. Henry, Jr., who, until recently, occupied that position.

A particularly strong combination is thus formed, as these companies have for years been recognized as the pioneers in the development of hydroelectric engineering, and the merged experience of the two companies, together with patents now controlled by the Pelton Water Wheel Company, forms an organization with the best possible facilities to cope with any problems in the field of hydraulic engineering.

In addition to Pelton and Doble tangential water wheels, the Pelton Water Wheel Company manufactures the Pelton Francis turbine, adapted for medium heads and large powers, besides a line of high grade centrifugal and turbine pumps. Pelton oil pressure governors are also a feature of this company's product.

The Atlantic department of the Company, with offices in New York City, has recently completed large and well equipped machine shops in Harrisburg, Pa., the two points of manufacture thus facilitating deliveries to all parts of the world.

ELECTRICAL CONTRACTORS' NOTES.

Bids are being called for electric work on the Sacramento Armory.

The General Electric Construction Company was awarded the wiring for a five-story apartment and stores at Sixteenth and Valencia streets at $3,500.

The John G. Sutton Company received the contract for wiring St. Luke's Hospital at $15,250; also the contract for the power plant, and heating and ventilating equipment at $25,600.

The cost of building in San Francisco for the year 1911 was $24,431,268, against $22,873,942 for 1910. Oakland, $7,118,197 in 1911, $7,078,635 in 1910; Los Angeles, $23,004,185 in 1911, $21,684,100 in 1910.

The Pacific Gas and Electric Company has commissioned Architect E. C. Heminway to prepare plans for a five-story class A building in Sacramento, the cost of which will be about $100,000.

The electric work for the Girls' High School was awarded to the Standard Electric Company for the sum of $5,497. Other bids were: Butte, $5,737; Sutton, $6,280; Central, $6,290; General Electric Construction Company, $6,467; McFell, $6,695; Turner, $6,700; National, $7,800.

TRADE NOTES.

The Allis-Chalmers Company has sold the Salt River Valley Consumers' Association of Phoenix, Ariz., twelve 500-kw. transformers for the distribution of power generated at the electric generating plant supplied from the great Roosevelt dam.

Kalenborn & Pahl, electrical contractors, San Francisco, report the completion of a difficult job of submarine cable work for the United States Government which has recently connected Angel Island with an 11,000 volt power cable to the mainland at Tiburon across Raccoon Straits. They also have just finished the installation of a 100 h.p. motor-pumping plant near Woodland and are at work on another plant of like size for the Oulton Land Company on Twitchell Island,

NEWS NOTES

INCORPORATIONS.

LOS ANGELES, CAL.—International Fuse Lighter & Electric Mfg. Company has been incorporated for $1,000,000. by H. H. Mears, D. M. Potter, J. Auchell, W. W. Bearman and F. Fette.

LOS ANGELES, CAL.—Central California Gas Company has been incorporated for $100,000 capital stock, with directors C. S. Forney, J. H. Straede, De W. S. Childress, F. R. Miller and H. B. Landes.

SAN DIEGO, CAL.—Vulcan Water Company has incorporated with capital stock of $1,000,000. Will operate in all kinds of irrigation and water supply enterprises. Incorporators are Wm. G. Henshaw, Ed Fletcher and others.

TRANSMISSION.

LINDSAY, CAL.—The Tulare County Power Company, through Purchasing Agent Holley of Lindsay, Cal. has given an order for Locke insulators to equip 150 miles of transmission line to Pierson, Roeding & Co., and 110 tons of wire to the National Conduit & Cable Company.

RED BLUFF, CAL.—The Oro Water, Light & Power Company, operating in Butte County, and with head offices in San Francisco, has purchased the interests of the Butte and Tehama Power & Irrigation Company and the Sierra Irrigation Company. The Oro Company has been operating in and about Oroville for many years, and lately has been preparing to erect additional plants and extend its lines to Sacramento and on to San Francisco bay. A large generating plant on Mill Creek will be erected at once.

OROVILLE, CAL.—A force of surveyors in the employ of the Oro Electric Corporation, has located its camp near Central House, south of this city. A course to be followed by the power line from Humbug Valley in Plumas County is being surveyed. During the present year the erection of a power plant at Humbug Valley will be started. The power line will leave the mountains at Pentz, about 15 miles north of this city, will come here and then on to Marysville and Sacramento, whence it will continue to San Francisco.

ILLUMINATION.

CASTLE ROCK, WASH.—The Castle Rock Coal, Light & Power Company will build an electric lighting system and power system here.

OCEANSIDE, CAL.—The Oceanside Electric Company has been notified of the expiration of its three years' lighting contract with the city.

EMMETT, IDAHO.—The report that the Idaho-Oregon Light & Power Company will build a dam across the Payotte River, near here, at a cost of $250,000 is erroneous.

PASADENA, CAL.—C. W. Koiner, general manager of the municipal lighting department, was given permission to spend $3090 on operating supplies and construction material.

LOS ANGELES, CAL.—A gas plant is now being erected at Bell Flower Acres. Mains will be laid in a short time and gas will be supplied to the entire tract for heating and lighting purposes.

ROSEVILLE, CAL.—At the meeting of the Roseville Board of Trustees bids were called for electric energy for a period of five years. Only one bid, that of the Great Western Power Company, was offered. The terms of the resolution of the board were accepted and the price set at 1½c per kw. hour.

TACOMA, WASH.—An announcement was made by District Manager R. T. Laffin of the Stone & Webster interests in the Northwest, of the consolidation of the various companies operating west of the Cascades under one general management. The new company is to be known as the Puget Sound Traction, Light & Power Company.

MARTINEZ, CAL.—The Town Trustees by a vote of 3 to 2 have rejected the offer of the Great Western Power Company to pay the 2 per cent on the gross earnings of the company for light, heat and power in this city. The trustees ordered that the suit pending in the Superior Court to enjoin the company from proceeding with work in the town be carried to the Supreme Court.

TRANSPORTATION.

LOS ANGELES, CAL.—Mayor Alexander vetoed the resolution adopted by the City Council giving the Pacific Electric permission to electrify the Santa Monica Air Line.

WILLOWS, CAL.—A franchise has been granted by the Corning trustees to F. H. Ridley for a mono-rail railroad, proposed to be built from Paskenta to Red Bluff via Corning.

SAN DIEGO, CAL.—The San Diego Electric Railway Company has been granted a franchise to operate for a period of forty years, a street railway on certain streets of the city.

MONTEREY, CAL.—An electric railway is to be built from Pacific Grove to Pebble Beach. A clearing of the right of way through 17-mile reservation from Lake Majela, the end of the Southern Pacific road, is now being made. The road is to be built by the Pacific Improvement Company.

SANTA CLARA, CAL.—James P. Sex, representing the Peninsular Railway Company, appeared before the Board in regard to the proposed franchise for a railroad. The franchise is to run 50 years. The board decided to advertise the franchise for sale, the bids to be opened February 12th.

VALLEJO, CAL.—President T. T. C. Gregory of the Vallejo & Northern Electric Railway Company, which proposes to join Vallejo and Sacramento with an electric line, announces that bids will be opened in the San Francisco office in the near future for the terminal work, which is to be performed in this city. The job will consist mostly of grading.

OAKLAND, CAL.—As the result of an active campaign started several months ago by the members of the Elmhurst Board of Trade the Key Route has agreed to extend the Key Route Twelfth-street extension from Thirteenth avenue and East Fourteenth street to the eastern limit of Elmhurst. This change will take place within the next two weeks, or as soon as the new cars are ready.

SAN JOSE, CAL.—Five miles of new electric line connecting Meridian Corners and Santa Clara will be built at once by the Peninsula Railway Company. The road will connect the company's line at the former place and the Southern Pacific depot in the latter city. Work on the new line, which will eventually be a part of a system connecting San Jose and San Francisco on the west side of the bay, has begun at Meridian Corners and will be pressed rapidly.

SAN FRANCISCO, CAL.—A resolution has been drafted for presentation to the Supervisors for extending the permit under which the old Geary Street Railway Company can operate for 30 days from January 16. The present permit expires on that date. Commissioner Laumeister reported that the plans for the new cars for which bids are to be

asked will be ready in a few days, but probably will be referred to Bion J. Arnold, the Eastern expert, before advertising for bids.

SEDRO-WOOLEY, WASH.—The Whatcom County Railway & Light Company, Bellingham, is extending interurban service to this place and will construct a substation, depot and shipping facilities here.

SEATTLE, WASH.—A permit has been granted by the Board of Public Works to the Seattle Electric Company to install an additional curve at First avenue and Yesler way and to double-track Twelfth avenue South, between Lane and Norman streets.

SAN FRANCISCO, CAL.—Paul Shoup of Los Angeles, vice-president of the Pacific Electric road system in Southern California, an adjunct of the Southern Pacific, is at the Palace. Shoup is in the city conferring with President Sproule of the latter company regarding plans for extending the electric system in many directions during this year. Recently the electric road company authorized a stock issue of $100,000,000 and a bond issue of like amount. Money from the sale of these new bonds will be used for new lines from time to time, a definite start being made this year.

TELEPHONE AND TELEGRAPH.

KENNEWICK, WASH.—The Kennewick Valley Telephone Company has commenced work on the installation of new central energy system, to take the place of the present system.

WATSONVILLE, CAL.—The Carlton District Telephone Company has organized and elected officers. Work has commenced on the erection of a line to serve the residents in that district. Walter E. Pecham is president.

CHICO, CAL.—The first step toward the ultimate lighting of the downtown business streets with electroliers was taken when the members of the Board of Trustees adopted a design of electroliers submitted by John Waterland.

SANGER, CAL.—The application of the Sanger Telephone Company for a 25-year franchise for a telephone system in this city was heard and the ordinance granted. The franchise is to be advertised for bids and granted to the highest bidder.

HOQUIAM, WASH.—Two new rural telephone lines are now being promoted and indications are that one of them will be built within the next few months. The proposed lines are to give Pacific Beach and Noclips connections with Hoquiam.

VALE, ORE.—Juntura will have telephone connections with Boulah within the next 30 days, as a company of the people of that section has formed for the installation of a line for a distance of 12 miles. Persons backing the enterprise are Dan Gilkey, R. L. Scott, D. F. Murphy.

TULARE, CAL.—At the annual meeting of the Tulare Home Telephone Company the Board of Directors were elected as follows: T. D. Blodgett, M. G. Cottle, Sol Rosenthal, S. B. Anderson, and G. C. Harris. The officers are G. C. Harris, president; T. L. Blodgett, vice-president; Sol Rosenthal, secretary. The company is contemplating a large increase in the farmers' lines. All lines outside of the city limits must be erected at the expense of the farmers, but the company gives them a rate of 50c per month. The company is now furnishing 725 phones.

SAN FRANCISCO, CAL.—Both the Pacific Telephone & Telegraph Company and the Bay Cities Home Telephone Company have each signified their willingness to carry out the consolidation which has been talked of for some time. The Bay Cities Telephone Company has filed with the Board of Supervisors a draft of an ordinance permitting the consolidation, together with a petition for its enactment signed by Robert A. Frick, vice-president, and G. B. Ocheltree, secretary of that company. Henry T. Scott of the Pacific Telephone & Telegraph Company has stated that the consolidation would be effected if the people wished it. He does not exactly say that the terms have been determined, but the companies are near enough together to prevent any failure of the negotiations. The same is true of the situation in Berkeley and Oakland, the only other places where the Home company is operating in the bay region. Scott said that he thought there should be no objection to the consolidation as long as the Supervisors had the rate-making power, and stated that the service of the Pacific company, which has been improved since the competition, would be continued at its present level of efficiency. The proposal made to the Board is that in addition to the 600 free telephones given the city it shall have the free use of two of the conduits of the Home company for fire and police lines; and that the Pacific company "will be allowed, for rate fixing purposes, a return only on such portion of the property acquired from the other company as may be reasonably useful and necessary in the operation of its system." It is also stated that the form of ordinance presented was drafted by the San Francisco Chamber of Commerce. In the petition signed by Frick and Ocheltree are the following paragraphs: "During the eighteen months in which this company has operated the Home system in San Francisco, notwithstanding that excellent service has been given, the difficulty in securing subscribers, and the repeatedly expressed views of the citizens of San Francisco, have made it clear that the people of this city are strongly opposed to the maintenance of two telephone systems, and greatly desire that they be consolidated. In response to this public demand, this company and the Pacific Telephone & Telegraph Company, with the permission and approval of your honorable Board, are ready to merge their respective telephone systems in this city. As the Pacific Telephone & Telegraph Company covers the entire Pacific Coast this consolidation of the systems in San Francisco can only be made by means of a transfer of the property of this company to the Pacific Telephone & Telegraph Company."

WATERWORKS.

CARLTON, ORE.—Carlton will hold an election February 5th to vote bonds amounting to $40,000 for the construction of the proposed gravity water system.

BEAVERTON, ORE.—Engineers have estimated that an ample supply of water can be obtained by Beaverton for $10,000. The plan is to sink wells and pump the water by electric power.

ELLENSBURG, WASH.—The City Council has awarded the contract for the construction of the $150,000 municipal waterworks and distributing system to the International Contract Company of Seattle.

SPOKANE, WASH.—Approximately $2,000,000 worth of stock is being issued to stockholders of the Washington Water Power Company. The money is to be used for extensions and improvements for the entire system of the company, and for work at Long Lake, for power plants and street paving.

MODESTO, CAL.—This city will soon vote on a bond issue of $82,500 for the improvement of the municipal water system. The plans of the council mean the entire rebuilding of the system. The changes and additions proposed include new mains to cost $41,724; additional hydrants, $3,141; additions and changes in the pumping plants including the purchase of the Cressey pump at the old gas works, extensive improvements at the Eighth and Seventeenth streets and Wisecraver stations, $22,000; other improvements, including two tanks of a capacity of 100,000 gallons each, $11,990.